

Carbon Assessment Tools:

The Need for Field Validation and Verification (COMET-VR and SCI)

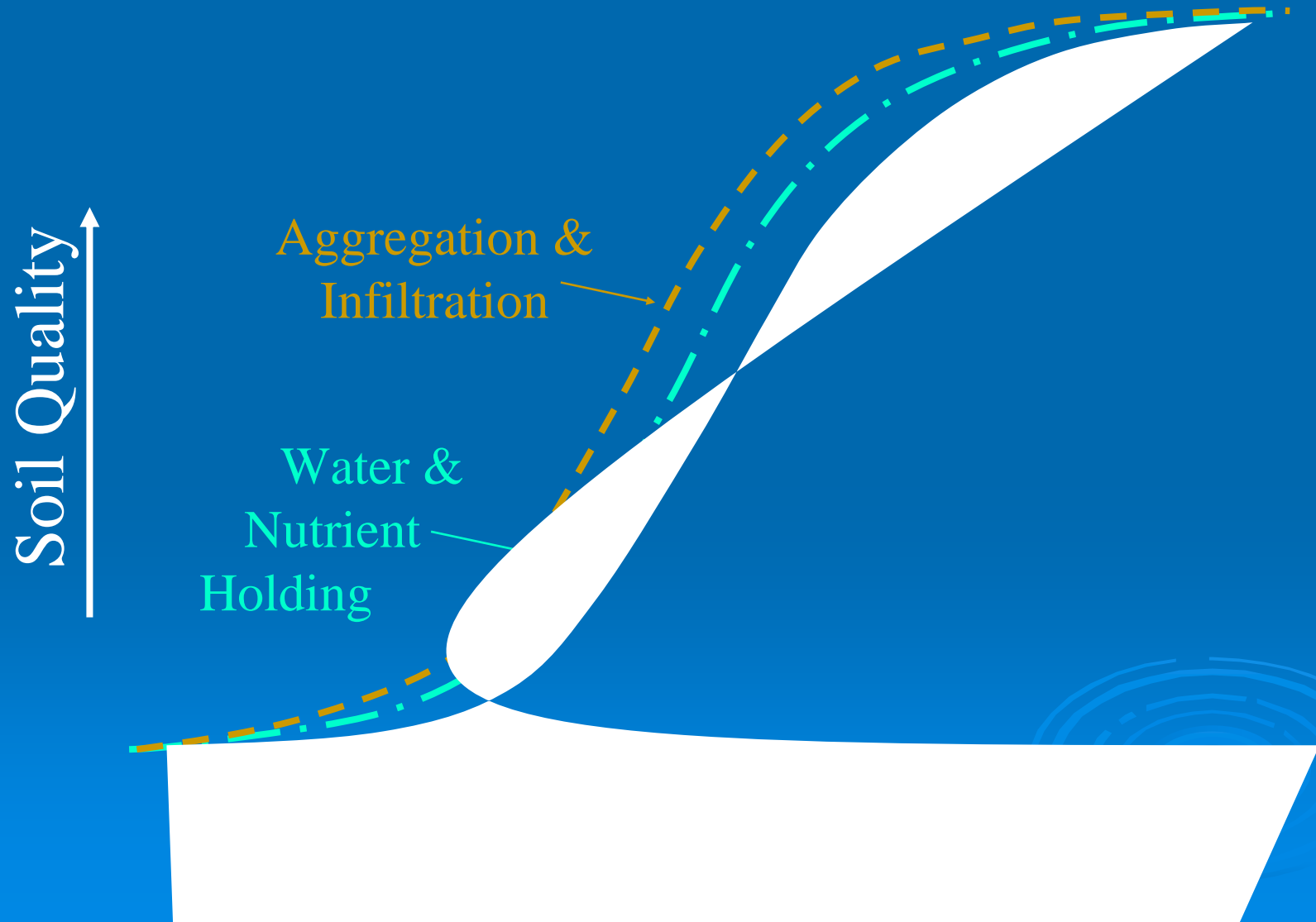
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ENTSC





Benefits of Soil Carbon





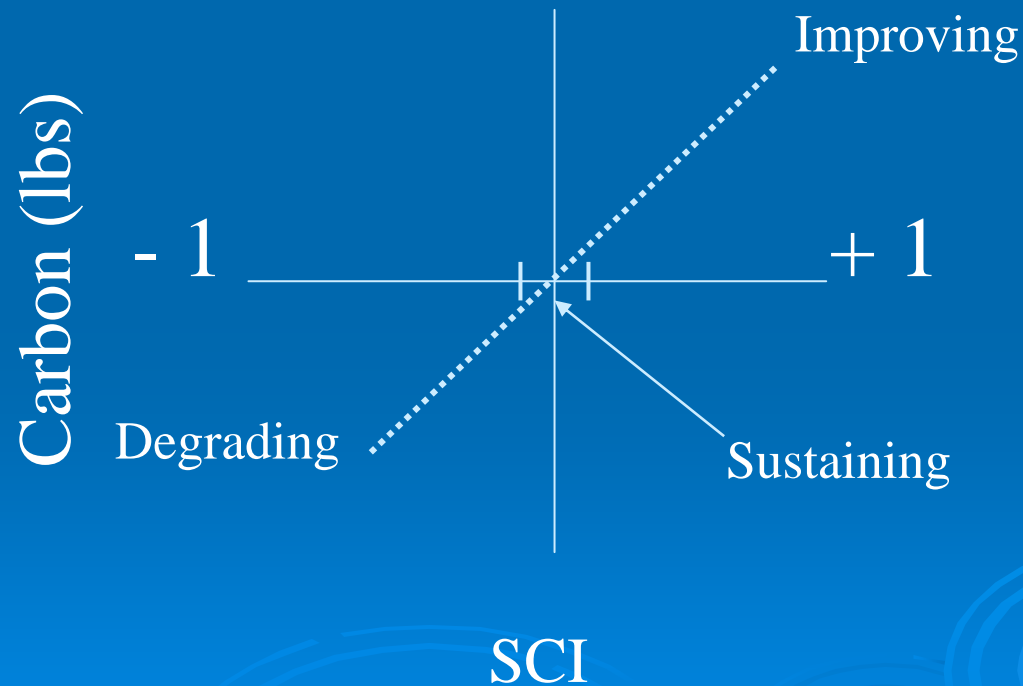
The Soil Conditioning Index (SCI):

- Expresses the effects of the system on organic matter trends as a primary indicator of soil condition.
- Provides a means to evaluate and design conservation systems that maintain or improve soil condition



Soil Conditioning Index

(SCI = Soil Disturbance + Plant Production + Erosion)



SCI Summary

- Tool for estimating soil quality condition
- Validated using long term research data
- Used for conservation assessment in CSP & CEAP
- Part of RUSLE2 output

COMET-VR

CarbOn Management Evaluation Tool for Voluntary Reporting

- Released on March 23, 2005
 - REPORTING CRITERIA
 - **Accuracy**
 - **Reliability**
 - **Verifiability**
- Interagency Initiative
 - DOE, **USDA**, EPA, NASA....
- Universities

COMET-VR Inputs

➤ MODEL REQUIREMENTS

- **Location**
- **Field or Parcel information**
- **Soil Information - Texture**
- **Management/**
 - **Cropping history**
 - **Tillage**

COMET-VR SCENARIOS

➤ Historic

- Pre 70's: grazing
- 1970-1990s: CS under CT

➤ Current :

- 1990-present (same as 70's-90s)

➤ Reporting Period:

- Rotation: (CS/CSWW)
- Tillage: (CT/ MT/ NT)

Objectives

- Compare SCI and COMET-VR as soil carbon assessment tools
- Determine the principal factors contributing to differences in model outcomes
- Assess regional differences, if any

Approach

➤ Rotations

- Corn-soybean
- Corn-soybean-winter wheat
- Wheat Potato
- Wheat 4-yr Alfalfa

➤ Tillage

- Conventional till
- Mulch-till
- No-till

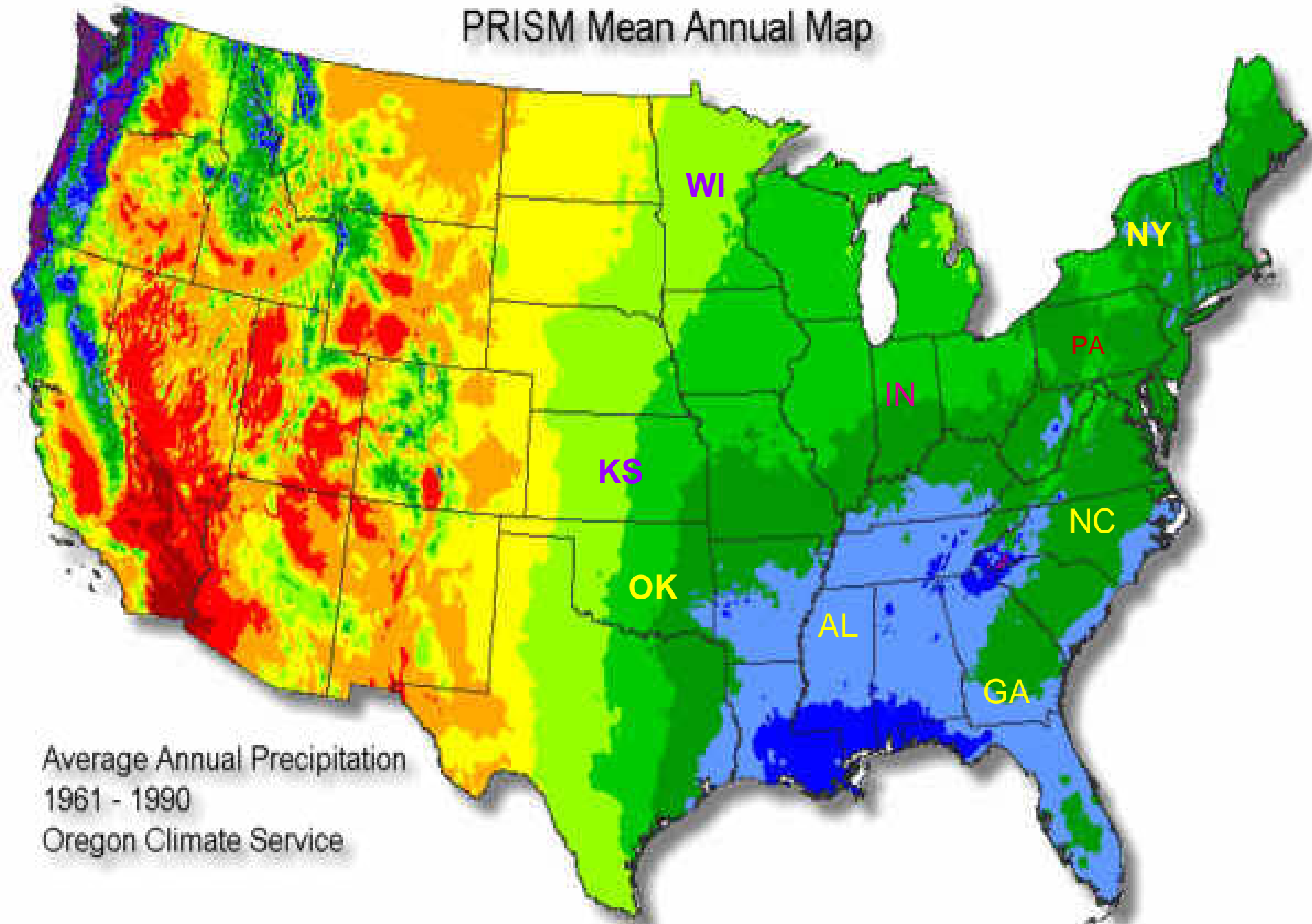
➤ Soil Texture

- Loamy sand
- Sandy loam
- Silt loam
- Clay loam
- Silty-clay loam

(textural gradient)

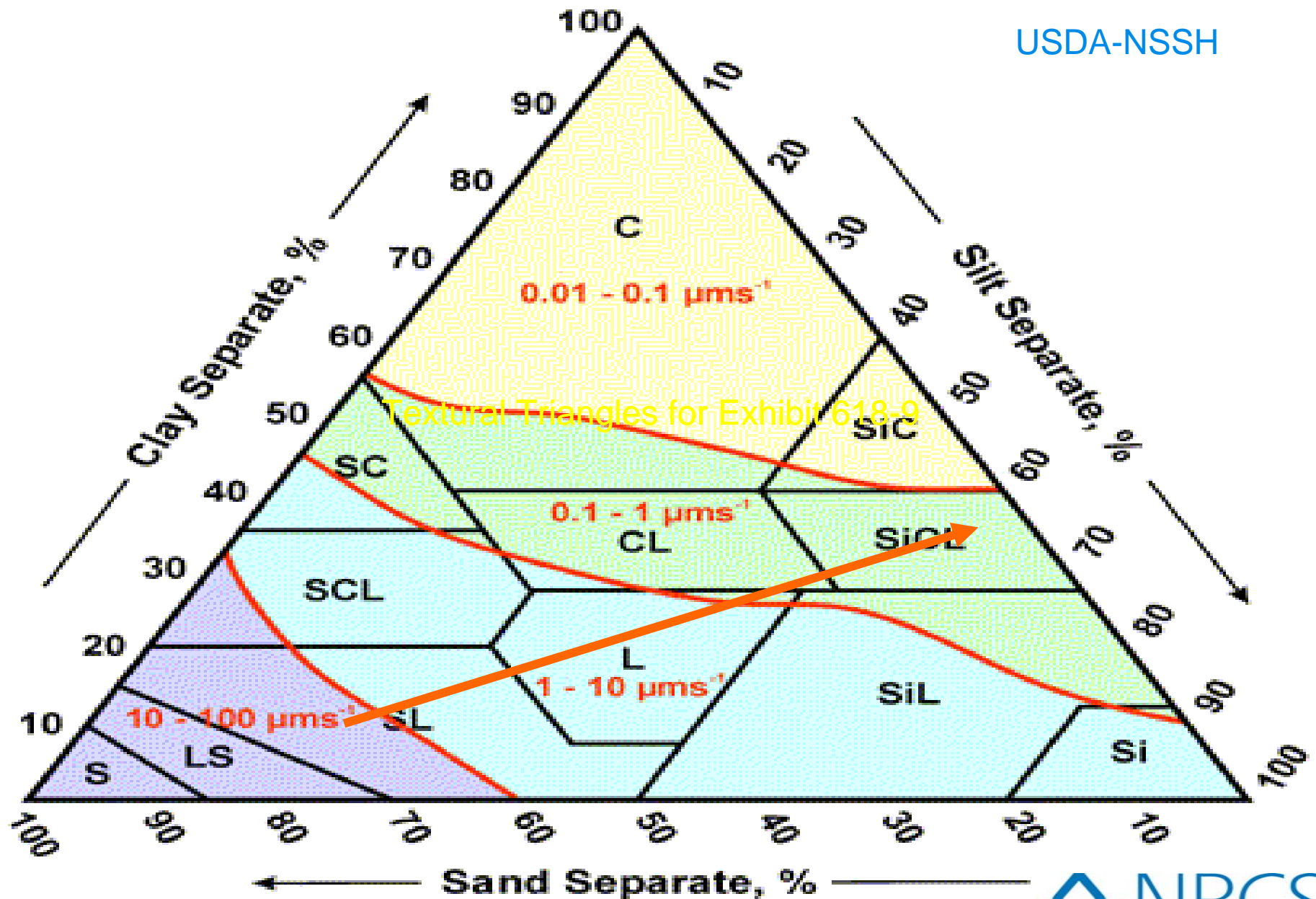


PRISM Mean Annual Map



Ksat for Medium Bulk Density

USDA-NSSH



Results



Effect of Tillage on Soil Organic Carbon across rotations and texture for for the CS-CSWW

State: OK NC NY KS GA AL IN WI PA
County: Adair Alamance Albany Anderson Grady Madison Marion Pierce York

_____ Kg C ha⁻¹ yr⁻¹ _____

COMET-VR

Tillage

NT	66.3a	216.4a	97.9a	93.1a	199.1a	59.1a	93.6a	105.1a	60.9a
MT	-32.5b	144.0b	68.1b	-2.9b	124.3b	-15.4b	-6.9b	-4.3b	-40.3b
CT	-76.8c	-18.6c	-98.7c	-27.1c	-18.8c	-54.7c	-32.3c	.30.0c	-86.9c

SCI

NT	213.9a	231.7a	292.9a	235.7a	167.2a	288.8a	401.7a	394.4a	363.6a
MT	20.3b	-101.0b	132.3b	68.1b	123.4b	77.8b	229.1b	211.8b	200.9b
CT	-141.9c	-275.1c	15.7c	-44.4c	-306.0c	-94.2c	76.3c	69.7c	22.1c

Effects of Rotation on Soil Organic Carbon Pooled across Tillage and Texture for CS-CSWW

State	OK	NC	NY	KS	GA	AL	IN	WI	PA
County	Adair	Alamance	Albany	Anderson	Grady	Madison	Marion	Pierce	York

_____ Kg C ha⁻¹ yr⁻¹ _____

COMET-VR

Rotation

CS	-58.5b	106.6b	64.5a	45.5a	98.9b	-38.1b	38.5a	42.4a	-59.1b
CSWW	29.9a	121.3a	-19.7b	-3.4b	104.2a	30.8a	-2.2b	4.8b	14.9a

SCI

CS	20.6b	-28.6a	153.6b	47.4b	-158.5b	21.1b	168.6b	134.8b	119.1ba
CSWW	40.9a	-67.7b	200.3a	125.5a	-16.5a	160.4a	302.9a	3159.a	272.0a

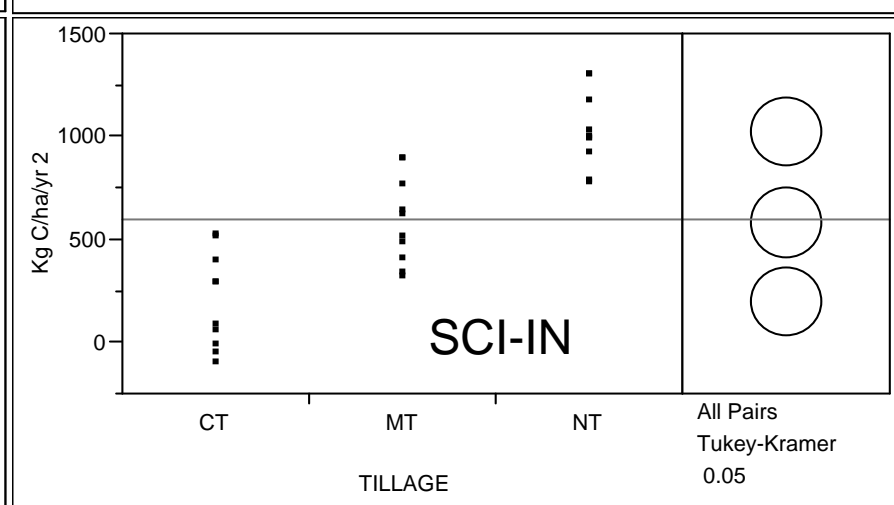
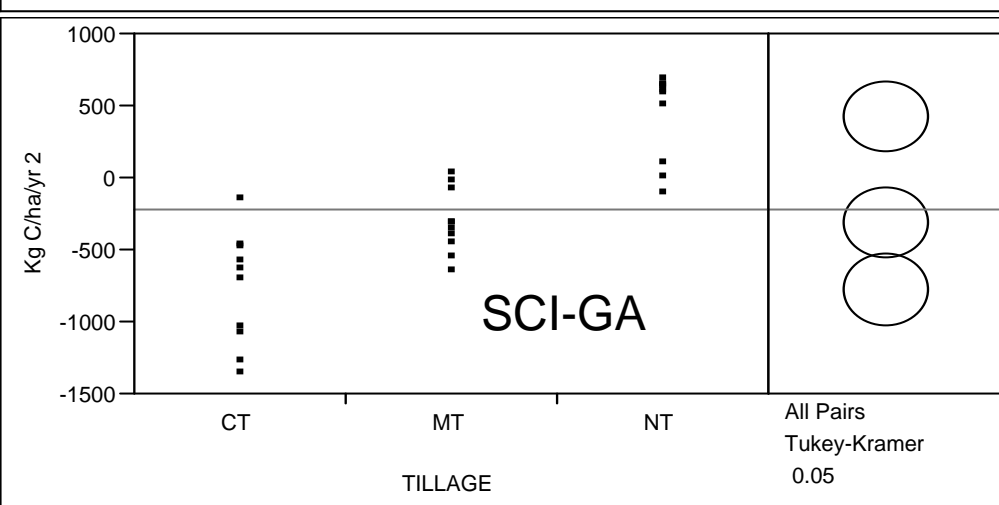
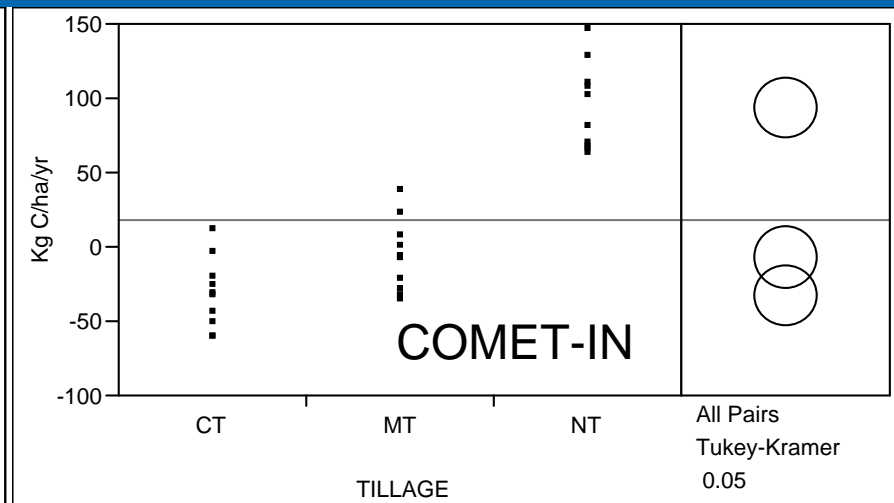
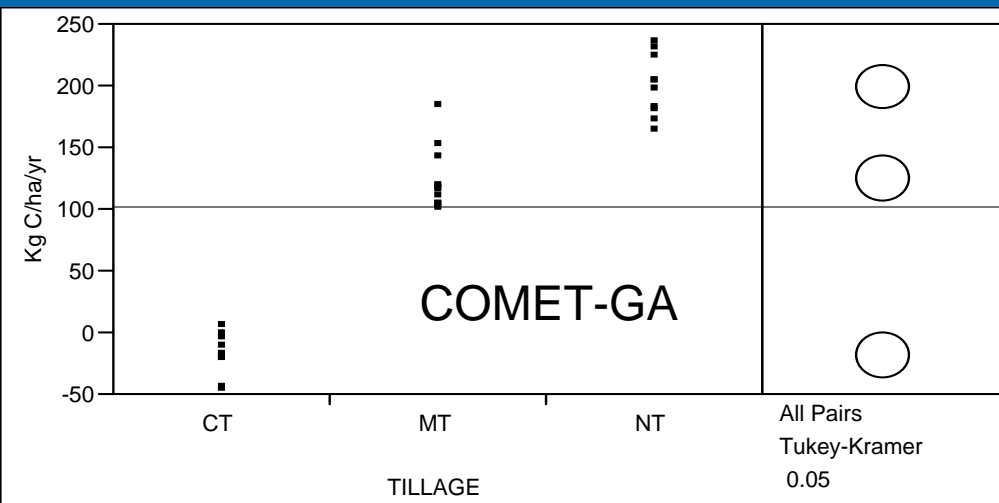
Effects of Texture on Soil Organic Carbon pooled across Tillage and Rotations for the CS-CSWW

State County	OK Adair	NC Alamance	NY Albany	KS Anderson	GA Grady	AL Madison	IN Marion	WI Pierce	PA York
<hr/> Kg C ha ⁻¹ yr ⁻¹ <hr/>									
<u>Texture</u>	<u>COMET-VR</u>								
SiCL	- 22.8c	88.5a	9.3c	11.9d	80.3a	21.3d	4.5d	18.3b	-35.1c
CL	-12.3b	102.3a	13.1c	18.7c	96.0a	-11.9c	3.c	20.9b	-22.8b
SiL	-53.0d	106.4a	31.4b	12.7cd	91.1a	-20.9d	9.7c	19.4b	-51.9d
SL	-11.9b	124.3a	10.8c	27.6b	116.1a	4.1b	24.3b	27.6a	-22.4b
LS	28.4a	148.2a	47.4a	34.3a	124.3a	31.7a	39.2a	31.7a	21.7a
 <u>SCI</u>									
SiCL	21.0bc	-54.3a	143.7c	99.a	-112.7a	98.1ab	275.6b	268.3a	247.8a
CL	58.0a	-33.0a	188.3a	94.2a	-92.2a	122.5a	282.0a	252.4ab	236.4a
SiL	-2.6c	-78.3a	123.7c	62.0a	-73.7a	51.2b	191.2d	213.1c	164.7c
SL	39.9ab	-38.8a	158.8b	79.9a	-8.24a	96.2ab	237.1c	227.6bc	178.0b
LS	37.5ab	-36.4a	118.3e	96.2a	-6.5a	85.9ab	192.7d	165.2d	150.8d

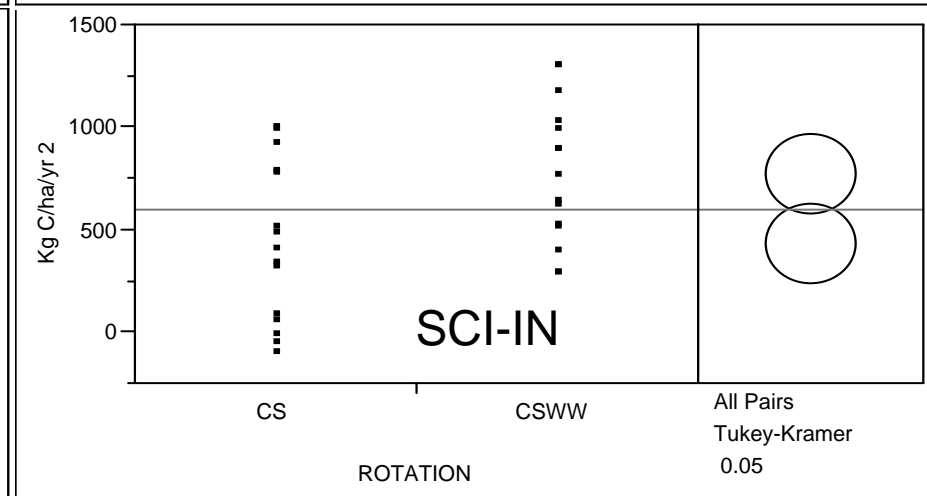
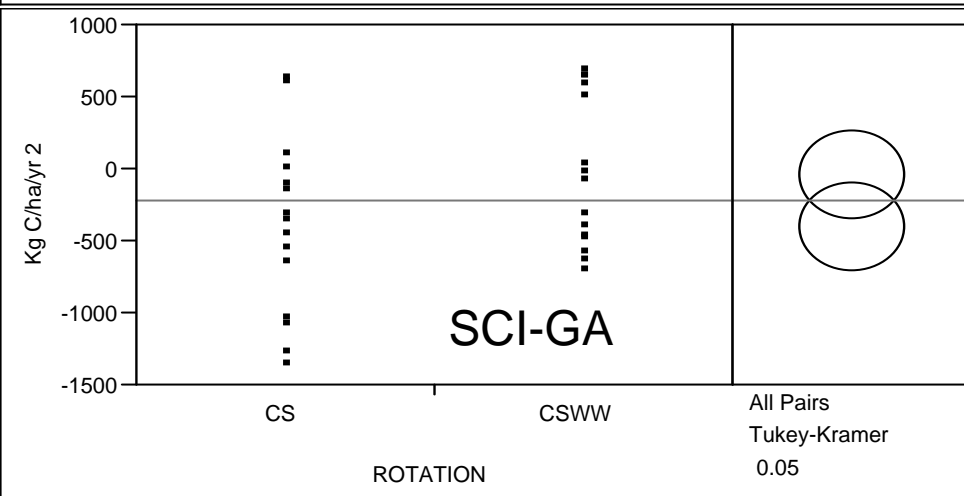
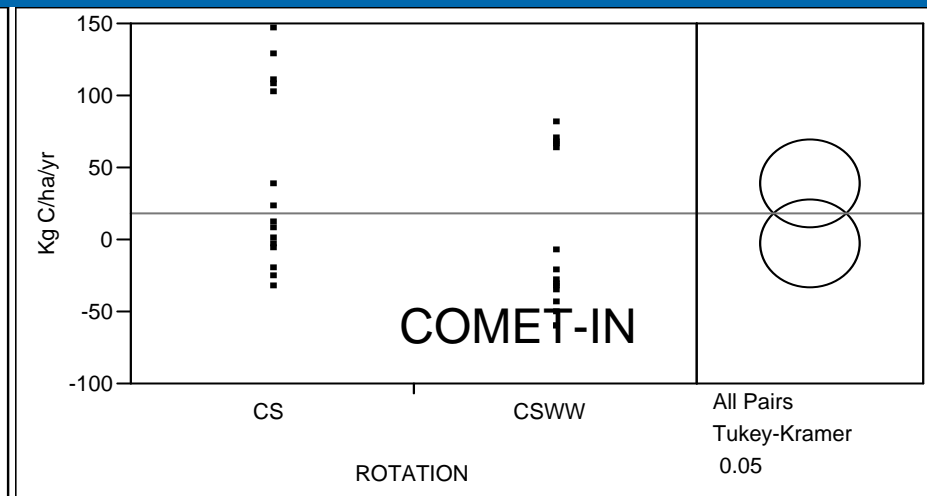
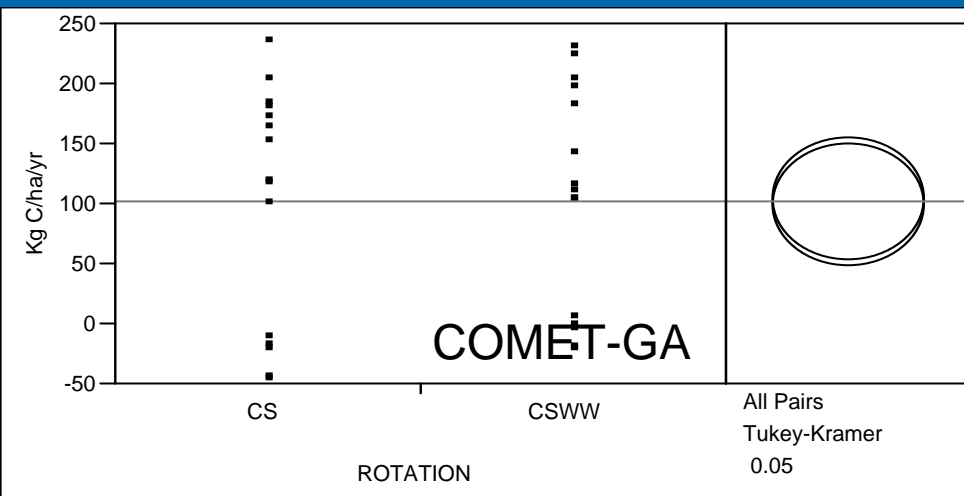
Means within each location followed by the same letter are not significantly different

SiCL= silty clay loam; CL = clay loam; SiL = silt Loam; SL = Sandy loam; and LS = Loamy sand

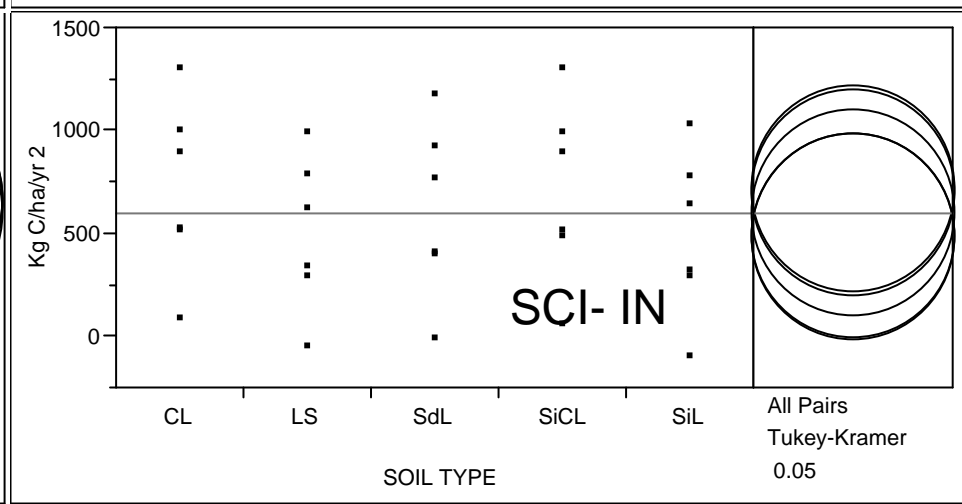
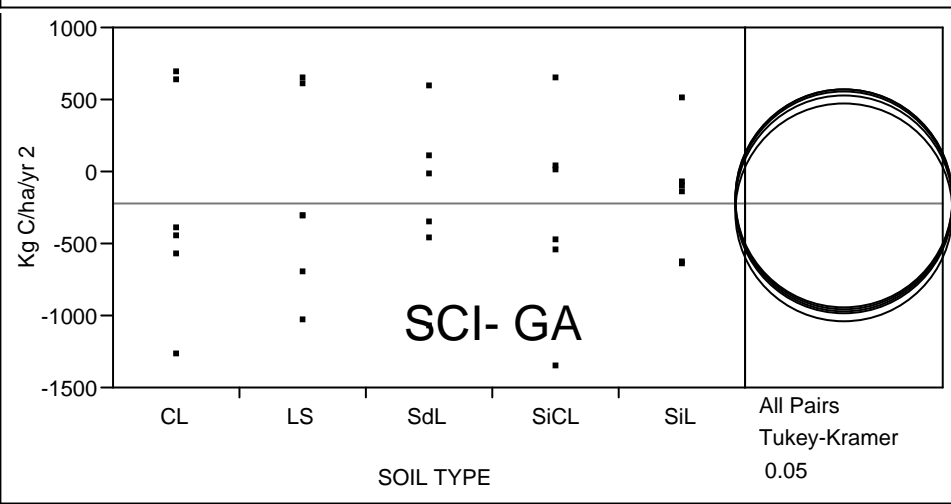
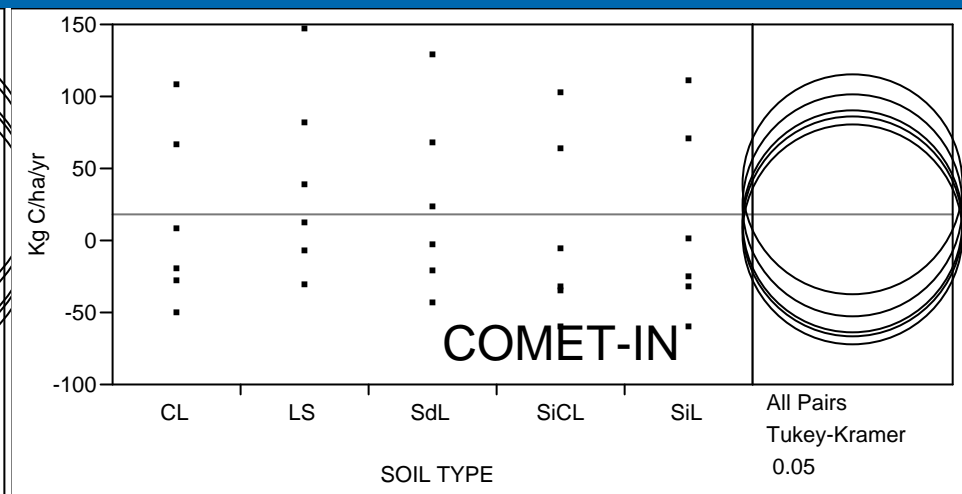
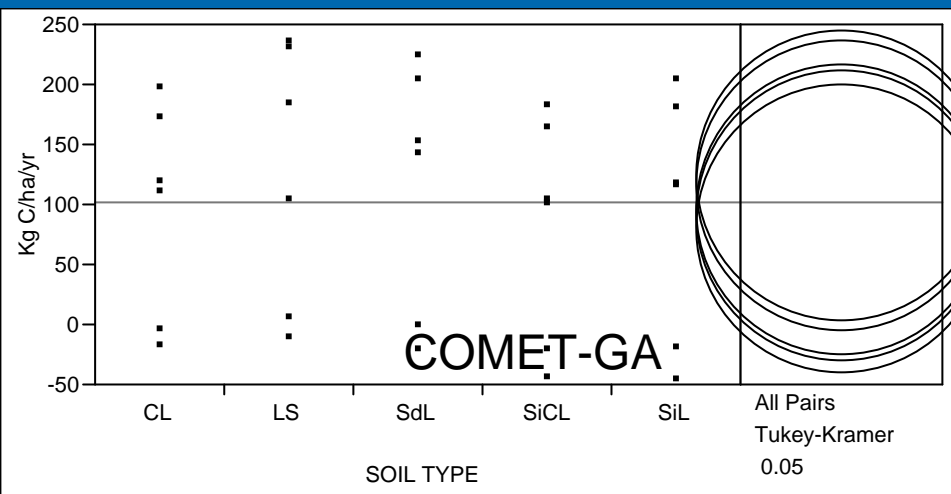
Effect of Tillage on Soil Carbon for Georgia and Indiana

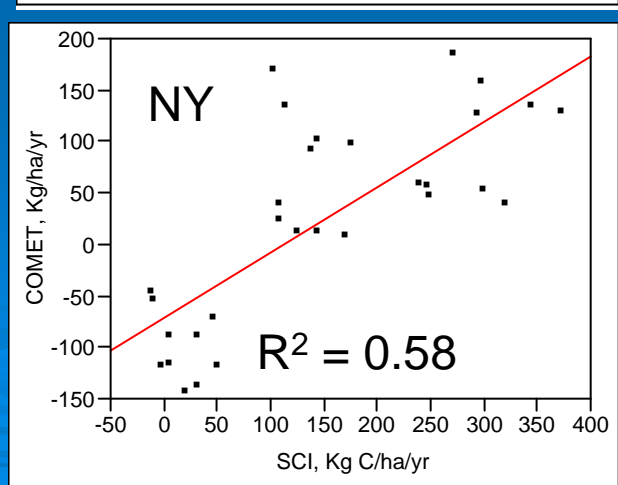
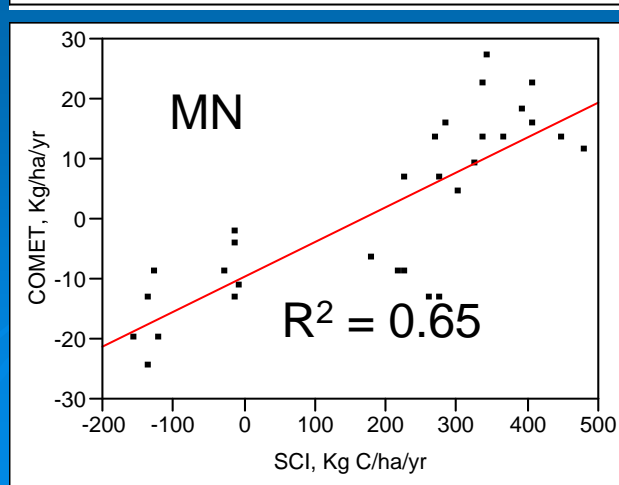
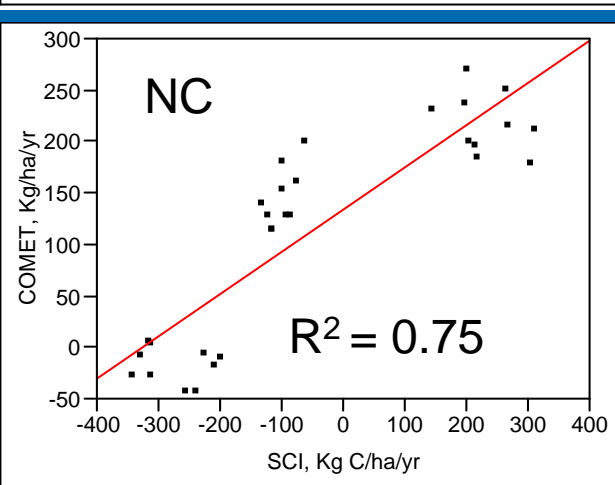
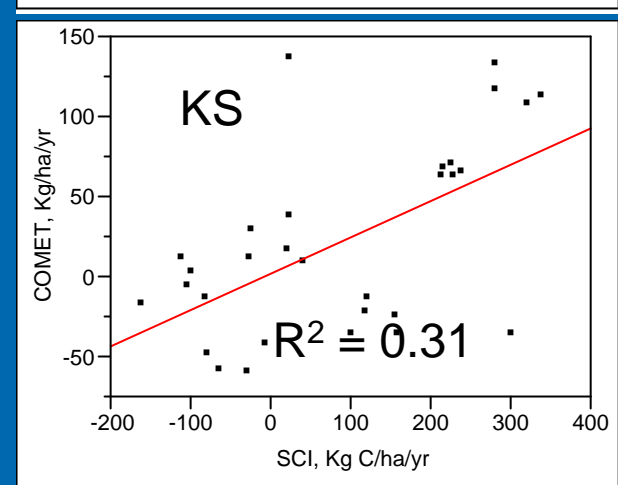
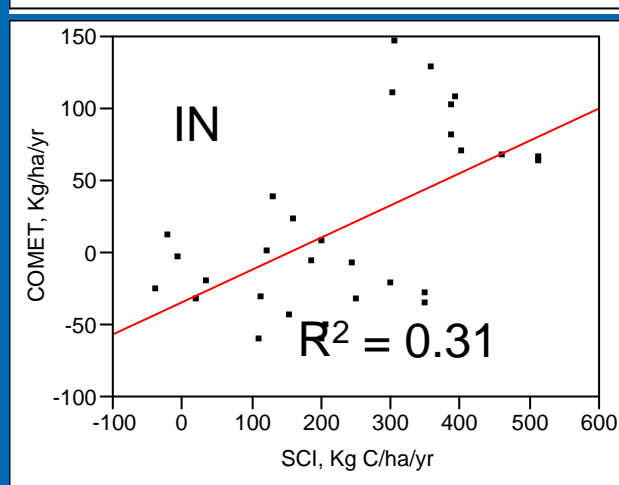
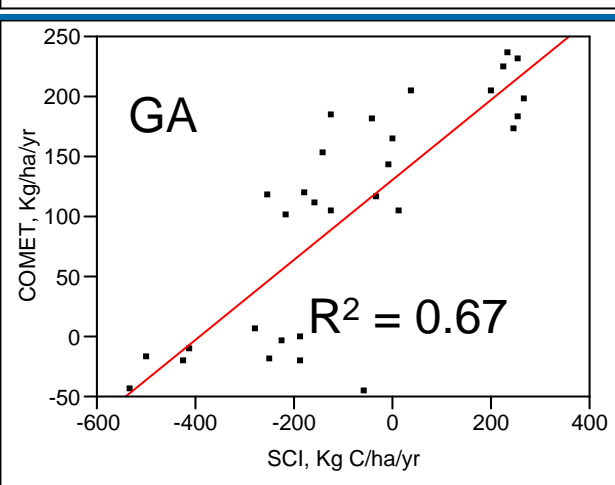
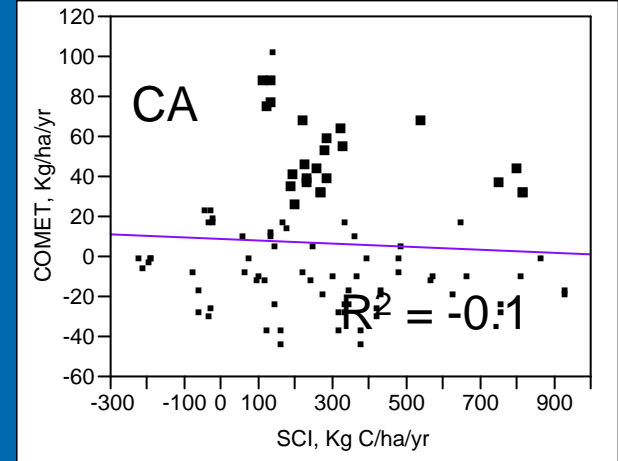
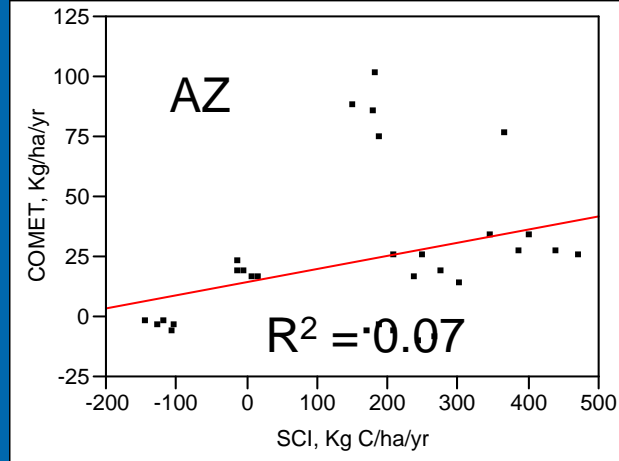
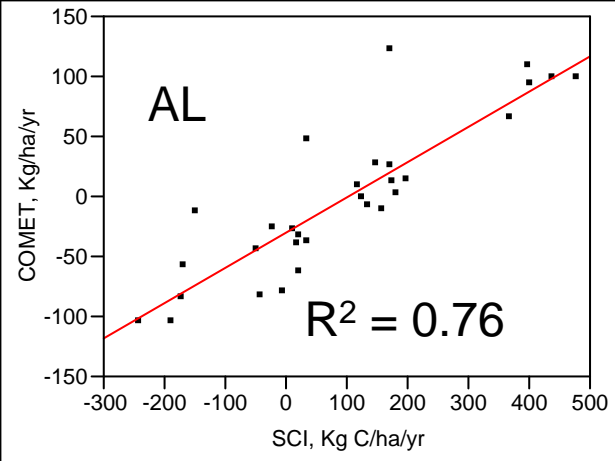


Effect of Crop Rotation on Soil Carbon for Georgia and Indiana



Effect of Soil Texture on Soil Carbon for Georgia and Indiana





Conclusions-Tillage

- COMET-VR and SCI predicted highly significant tillage effects on SOC for all locations ($p < 0.0001$)

The ranking for tillage was: NT > MT > CT

- No net SOC loss for NT for all locations
- Mulch-till lost carbon at some locations but not others
- CT lost SOC for all locations except IN, NY, PA and WI for SCI

Conclusions-Rotations

COMET-VR and SCI predicted highly significant rotation effects on SOC for all locations except COMET in GA and Imperial, CA.

- The rankings were:

COMET-VR

- **CSWW > CS** (MS, NC, OK, PA)
- **CS > CSWW** (IN, KS, NY, WI)

SCI

- **CSWW > CS** for all locations except NC

Conclusions-Texture

- **COMET-VR and SCI predicted significant texture effects on SOC for some locations but NOT along a textural gradient**
 - COMET-VR predicted higher SOC levels in coarse textured soils most of the time
 - SCI predicted higher SOC in fine textured soils most of the time

Conclusions Interactions

Both models predicted significant tillage*texture, tillage*rotation and texture*rotation interactions for some locations

- Outcomes were similar for the tillage*texture interaction for 5 out of 9 locations
- For the tillage*rotation interaction both models predicted similar outcomes for 7 out of 9 locations
- For the rotation*texture interaction both models predicted similar outcomes in 7 out of 9 locations

General Conclusions

- Models are useful tools for soil carbon prediction under various management scenarios
- Agreement between models range from good to poor
- Rapid in-field Carbon assessment tools are thus needed to verify model predictions

Related websites

➤ <http://cometvr.colostate.edu/>

http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

<http://soils.usda.gov/sqi/>